

BLACK & VEATCH

South Florida Water Management District
EAA Reservoir A-1 Basis of Design Report

January 2006

APPENDIX 9-5

**TASK 5.3.1.10.2. GROUNDWATER MODEL
DOCUMENTATION MEMORANDUM**

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TECHNICAL MEMORANDUM

South Florida Water Management District
EAA Reservoir A-1
Work Order No. 5

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Task 5.3.1.10.2 Groundwater Model Documentation Memorandum Seepage Evaluation

To: Shawn Waldeck, Rich Bartlett

From: Kris Hahn, Ken Jones, Paul Petrey

1. OBJECTIVE OF THIS MEMORANDUM

The purpose of this technical memorandum is to document the groundwater modeling software and input/output files used for the seepage evaluation.

2. GROUNDWATER MODEL SELECTION

The Groundwater Modeling System (GMS) Version 5.1 was chosen to evaluate of seepage from Reservoir A-1. GMS is a proprietary software application developed at Brigham Young University that is capable of expediting the development and analysis of three-dimensional MODFLOW groundwater models. This is the same application that the U.S. Army Corps of Engineers (USACE) is using for the Project Implementation Report (PIR).

The United State Geological Survey (USGS) released a modular three-dimensional finite-difference groundwater flow model called MODFLOW in the 1980s. The program was written in FORTRAN 77, and since the 1980s, several enhancements have been made. The current version of MODFLOW 2000 is supported by GMS. Source code and compiled versions of MODFLOW 2000 are public domain and can be obtained at <http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html>.

GMS is one of many different proprietary groundwater modeling applications which support MODFLOW, and it was chosen because its “conceptual modeling approach” of developing groundwater models. With the conceptual modeling approach, features such as rivers, lakes, and

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wells can quickly be added to the model using features objects such as arcs, polygons, and points. GMS is well-suited for efficient development of large complex models such as the EAA Reservoir A-1 model.

3. GROUNDWATER MODELS

During development of the groundwater model, GMS was executed hundreds of times to eliminate modeling errors, determine the most appropriate methodology for hydrologic features, calibrate to the test cell data, perform a sensitivity analysis of the reservoir model, and simulate various reservoir seepage control alternatives at several reservoir water depths. Many of these model runs were saved, with the most important files being listed below.

3.1. Test Cell Calibration

3.1.1. *final_final_calib_4-23-05.gpr*

Final calibration of MODFLOW to the results of the test cells. See the Appendices for the Technical Memoranda for the test cell data used to calibrate the model:

- Appendix 6-2 Black & Veatch. *Seepage Evaluation – Task 5.3.1.9.2 Groundwater Model Memorandum*. South Florida Water Management District. 11 July 2005.
- Appendix 8-9 Black & Veatch. *Test Cell Program – Technical Memorandum 1*. South Florida Water Management District. 25 May 2005.
- Appendix 8-10 Black & Veatch. *Reservoir Seepage Analysis Technical Memorandum*. 31 May 2005.
- Appendix 8-6 Black & Veatch. *Seepage Control Technical Memorandum*. 31 May 2005.

3.2. Sensitivity Analysis

3.2.1. *Reservoir1.gpr through reservoir16.gpr*

Sensitivity analyses performed by varying reservoir depth, cutoff wall depth, seepage canal depth, and other variables input to the model. A comparison was also made between the hydraulic conductivity values determined by the USACE and the B&V MODFLOW and SEEP/W models.

3.3. Reservoir A-1 Preliminary Seepage Results

3.3.1. *Baseline.gpr*

Evaluation of existing conditions (pre-reservoir) to establish a baseline for groundwater flow.

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3.3.2. Scenario1.gpr through Scenario24.gpr

Various combinations of reservoir depth, cutoff wall depth, and seepage canal depth to compare the effect of seepage on surrounding areas.

Due to the large size and number of GMS input and output files, the files will be provided electronically in Appendix 9-6. See the following technical memoranda for a detailed explanation of the seepage results:

- Appendix 9-2 Black & Veatch. *Seepage Evaluation – Task 5.3.1.9.2 Groundwater Model Memorandum*. South Florida Water Management District. 11 July 2005.
- Appendix 8-10 Black & Veatch. *Reservoir Seepage Analysis Technical Memorandum*. 31 May 2005.
- Appendix 8-6 Black & Veatch. *Seepage Control Technical Memorandum*. 31 May 2005.

4. APPENDICES

Appendix 9-6 – will be provided on a DVD of the GMS models, along with a Microsoft Word document explaining the use of each model.